(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Veröffentlichungsnummer:
(11) Publication number:
(11) Numéro de publication:

0 833 693

Internationale Anmeldung veröffentlicht durch die Weltorganisation für geistiges Eigentum unter der Nummer:

WO 97/00727 (art.158 des EPÜ).

International application published by the World Intellectual Property Organisation under number:

WO 97/00727 (art.158 of the EPC).

Demande internationale publiée par l'Organisation Mondiale de la Propriété sous le numéro:

WO 97/00727 (art.158 de la CBE).

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B03C 3/74, 3/86 — A1

(11) International Publication Number: WO 97/00727

(43) International Publication Date: 9 January 1997 (09.01.97)

(21) International Application Number: PCT/SE96/00611

(22) International Filing Date: 10 May 1996 (10.05.96)

(30) Priority Data:
9502246-3 20 June 1995 (20.06.95) SE

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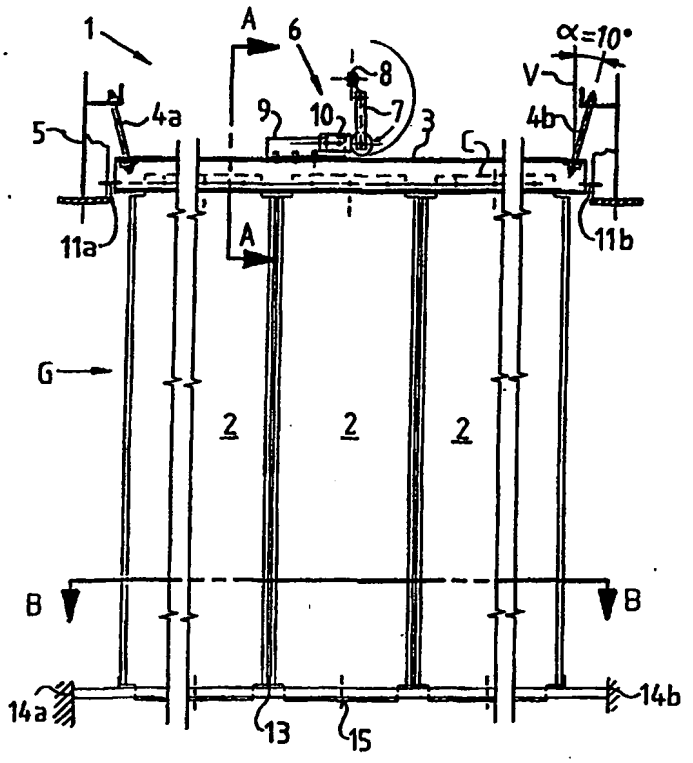
(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DE (Utility model), DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
With amended claims.

(54) Title: DEVICE IN AN ELECTROSTATIC PRECIPITATOR FOR THE SUSPENDING, CONTROLLING AND RAPPING OF COLLECTING ELECTRODES

(57) Abstract

A device in an electrostatic precipitator for suspending, controlling and rapping one or more collecting electrodes (2) arranged essentially vertically in one or more substantially parallel rows (1), said device comprising for each row (1) a substantially horizontally oriented carrier element (3), to which the upper ends of the collecting electrodes (2) are attached, connecting elements (4a, 4b) which connect the carrier element to the casing (5) of the electrostatic precipitator, control means (11a, 11b, 12a, 12b, 13, 14a, 14b) for controlling the motion of each row (1) of collecting electrodes in the transverse and/or longitudinal direction of the electrostatic precipitator, and a rapping mechanism (6) for rapping the collecting electrodes (2) of each row, comprising a rapping means (7), such as a rapping hammer, and an anvil (9) connected to the carrier element (3). The carrier element (3) of each row is separately suspended by means of said connecting elements (4a, 4b), thereby permitting, during rapping, a minimum horizontal pivoting motion restricted to each row (1) of collecting electrodes and occurring in the longitudinal direction of the electrostatic precipitator.



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DEVICE IN AN ELECTROSTATIC PRECIPITATOR FOR THE SUSPENDING, CONTROLLING AND RAPPING OF COLLECTING ELECTRODES

The present invention relates to a device in an electrostatic precipitator for the suspending, controlling and rapping of one or more collecting electrodes arranged essentially vertically in one or more substantially parallel rows and comprising for each row a substantially horizontally oriented carrier element to which the upper ends of the collecting electrodes are attached, connecting elements which connect the carrier element to the casing of the electrostatic precipitator, control means for controlling the motion of each row of collecting electrodes in the transverse and/or longitudinal direction of the electrostatic precipitator, and a rapping mechanism for rapping the collecting electrodes of each row and comprising a rapping means, such as a rapping hammer, and an anvil connected to the carrier element.

Electrostatic precipitators are usually composed of a plurality of successive precipitation fields through which dust-laden gas is passed to be cleaned. Each of the precipitation fields is divided into a plurality of parallel gas passages by means of a plurality of juxtaposed, earthed collecting electrodes vertically arranged in rows . These are usually in the form of rectangular, substantially plate-shaped, sectional metal sheets. Vertical discharge electrodes, to which a negative voltage is supplied, are arranged in each gas passage. Owing to corona discharges at the discharge electrodes, the dust-laden gas is ionised in the electric field in the gas passages. The negative ions are attracted by the collecting electrodes and, while moving towards these, collide with the dust particles of the gas, which are then charged and separated from the gas by being attracted by the closest collecting electrode, on which they are deposited and build up a dust layer. At regular intervals, the dust layer is loosened, by vibrations, from the collecting electrodes by these being mechanically affected by means of a rapping mechanism. The dust particles then fall into a collecting hopper associated with the respective precipitation fields.

The rapping mechanism can either be arranged at the top or at the bottom of each row of collecting electrodes and usually comprises a rapping hammer acting in a vertical plane about a rotary shaft which extends horizontally in the transverse direction of the electrostatic precipitator and to which the rapping hammer thus is connected, and an anvil. The rapping force for cleaning each row of collecting electrodes is generated

by the rapping hammer giving a horizontally directed rap via the anvil to a rapping means cooperating with the collecting electrodes, whereby a horizontal motion is imparted to the rapping means. This motion is transferred to the collecting electrodes in the form of a shock wave which spreads across these. Thus, the dust layer accumulated on the collecting electrodes is loosened.

A greater or smaller amount of the rapping force is absorbed by the suspension of the collecting electrodes during the cleaning operation. The amount of absorbed rapping force depends on the manner of connecting the collecting electrodes to the suspension and on the manner in which the suspension is connected to the casing of the electrostatic precipitator.

The collecting electrodes are usually controlled in the longitudinal as well as in the transverse direction of the electrostatic precipitator so as to be kept in exact positions and, thus, prevent flashovers.

There have been suggested various solutions of a device in an electrostatic precipitator for the suspending, controlling and rapping of its collecting electrodes.

For instance, EP 0 584 880 discloses a device for cleaning collecting electrodes in an electrostatic precipitator by rapping, the collecting electrodes being vertically arranged, successively in parallel rows. The collecting electrodes of each rows are, at their upper ends, attached between a pair of horizontally arranged longitudinal rapping beams and suspended from these, said beams thus also serving as carrier elements for the collecting electrodes. The rapping beams rest freely on a pair of supporting beams, between which the upper ends of the collecting electrodes are arranged. The pair of supporting beams rests, in turn, on a frame pertaining to the casing of the electrostatic precipitator. The pair of rapping beams thus is arranged so as to be able to slide, during rapping, horizontally on the supporting beams in the longitudinal direction of the electrostatic precipitator. During cleaning by rapping, the rapping force is transferred in the form of a shock wave by means of a rapping hammer to all the collecting electrodes of a row via an anvil, which is fixedly mounted on the pair of rapping beams of each row. On each side of the ends of the pair of rapping beams, laminated springs are mounted in the casing and cooperate with transverse so-called stop pins arranged at each end of the pair of rapping beams. A spring-back motion of the pair of rapping beams to its original position is permitted in connection with the rapping before the anvil is again hit by the rapping hammer. As a result, the laminated springs

control the row of collecting electrodes in the longitudinal direction of the electrostatic precipitator. The laminated springs also serve as control means in the transverse direction of the electrostatic precipitator. A drawback of the thus disclosed device is that a relatively great amount of the rapping force is absorbed by the casing during rapping and, thus, is lost. Besides, for each row of collecting electrodes, the device consists of a large number of components, which makes it mechanically complicated.

The mounting of the respective rows is carried out in such a manner that the upper ends of the collecting electrodes are first inserted between the pair of the supporting beams and are temporarily mounted therein by means of bolts. Each rapping beam is then arranged on both sides of the upwardly extending ends of the collecting electrodes and is mounted therein by means of bolts, whereupon the bolts in the pair of supporting beams are removed. The mounting procedure accomplished in this manner thus is complicated and time-consuming. The mounting of each row will probably also take place inside the electrostatic precipitator, which is a drawback compared with the technique of mounting the row outside the electrostatic precipitator so as to be inserted afterwards.

One object of the present invention thus is, in view of that stated above, to provide a new and improved device in an electrostatic precipitator for suspending, controlling and rapping its collecting electrodes, said device allowing a more efficient use of the generated rapping force when cleaning the collecting electrodes. A further object of the present invention is to provide a device for suspending, controlling and rapping, which is mechanically simpler and, consequently, easier to mount.

These objects are achieved by a device which is of the type stated by way of introduction and which according to the present invention is characterised in that the carrier element of each row is suspended separately by means of connecting elements, which as stated above connect the carrier element to the casing of the electrostatic precipitator, thereby permitting a minimum horizontal pivoting motion restricted to each collecting electrode row and occurring in the longitudinal direction of the electrostatic precipitator. The pivoting motion arising in rapping occurs owing to the separate suspension and thus fully independently of the remaining rows. By a restricted, minimum pivot motion is meant a pivoting motion which is less than about 5 mm of the carrier element in its longitudinal direction.

According to the present invention, the connecting elements of the carrier element preferably comprise two elongate rods, each making an angle α, relative to a vertical axis extending through each rod, in the range of about 5-35°, especially in the range of about 5-15°, in such a manner that said rods are positioned substantially in the plane of the row such that the distance between their lower ends is smaller than between their upper ends. In consequence of the carrier element being separately suspended in the above-mentioned fashion, the row of collecting electrodes will be self-centred after rapping, i.e. the row will immediately return to its correct original position.

The smaller the angle α the more movable the actual suspension, which means that a greater amount of the rapping force, relatively seen, will be absorbed by the casing, which results in poorer cleaning. On the other hand, the greater the angle α, the more unresilient the suspension, which also results in poorer cleaning. To achieve optimum cleaning, i.e. to transfer as great an amount as possible of the rapping force to the collecting electrodes, the angle is adjusted according to the present invention so that as small an amount as possible of the rapping force is absorbed by the casing. Moreover, the angle α should be adjusted so as to prevent too great a pivoting motion of the collecting electrodes. By such suspension, which is mechanically simple and easy to mount, a more efficient cleaning of the collecting electrodes is provided.

According to the present invention, the control means of the device consist of upper control elements cooperating with the carrier element, and/or lower control elements cooperating with the lower ends of the collecting electrodes. The upper control elements preferably consist of upper cam control elements cooperating with the end portions of the carrier element. Advantageously, the cam control elements extend substantially horizontally in the transverse direction of the electrostatic precipitator through a plurality of rows and thus prevent each row of collecting electrodes from moving in said direction. The upper control elements also serve as control means in the longitudinal direction of the electrostatic precipitator, especially in case of small angles α. By means of these upper control elements, which are mechanically simple and easy to mount, efficient control is achieved.

To further improve the control, in addition to the control provided by means of the upper control elements, lower control elements are preferably arranged at the bottom of each row and cooperate, as stated above, with the lower ends of the collecting electrodes.

According to a preferred embodiment of the inventive device, the lower ends of the collecting electrodes are loosely controlled by the lower control elements on the one hand in the transverse direction of the electrostatic precipitator by means of a longitudinally oriented, horizontal pair of rods, between which the lower ends of the collecting electrodes are arranged and, on the other hand, in the longitudinal direction of the electrostatic precipitator by means of spacer members arranged before, after and/or between the collecting electrodes.

A further alternative preferred embodiment of the inventive device is characterised in that the lower ends of the collecting electrodes are firmly controlled by the lower control elements in the transverse as well as longitudinal direction of the electric precipitator by means of longitudinally oriented, horizontal rods, to which the lower ends of the collecting electrodes are attached, preferably by means of bolts or rivets.

A common feature of the lower control is that each row of collecting electrodes is controlled in the transverse direction of the electrostatic precipitator by means of transversely oriented lower cam control elements arranged at the ends of said rods. The cam control elements advantageously extend substantially vertically in the transverse direction of the electrostatic precipitator through a number of rows and thus prevent the respective rows of collecting electrodes from moving in said direction. By means of these lower control elements, which are mechanically simple and easy to mount, efficient control is achieved. The lower and the upper control according to the invention is further designed with regard to thermal expansion.

According to the present invention, the anvil of the rapping mechanism is preferably directly fixedly mounted on the upper side of the carrier element and comprises a rapping shoulder, which is the rapping point of the rapping means, which is arranged in such a manner that the rapping point is located above the horizontal centre line of the carrier element. According to an alternative embodiment, the anvil can also extend across at least two rows of collecting electrodes in the transverse direction of the electrostatic precipitator. In this case, the anvil, which consists of e.g. a flat iron bar, is also directly fixedly mounted on the upper side of the carrier element of each row.

The rapping means of the rapping mechanism preferably acts in a vertical plane about a rotary shaft connected thereto and extending horizontally in the transverse direction of the electric precipitator, the rapping means giving the anvil a horizontally directed

rap during rapping. In dependence on the embodiment, the rap is given to the anvil either directly or indirectly via the above-mentioned rapping shoulder.

A general advantage of the inventive device is that each row of collecting electrodes can be mounted outside the electrostatic precipitator and then be inserted.

The invention will now be described in more detail with reference to the accompanying drawings, in which:

Fig. 1 is a schematic vertical section of a device according to the invention in parallel with a row of collecting electrodes in an electrostatic precipitator.

Fig. 2 is a horizontal section towards the collecting electrodes taken along line B-B in Fig. 1.

Fig. 3 is an enlarged view of a lower control element in Fig. 2.

Fig. 4 is a vertical section towards the collecting electrodes taken along line A-A in Fig. 1.

Fig. 1 thus is a schematic vertical section in parallel with a row 1 of collecting electrodes 2 in an electrostatic precipitator, which for each row 1 is provided with a device for suspending, controlling and rapping the collecting electrodes 2.

The electrostatic precipitator comprises a plurality of successive precipitation fields, each field consisting of a plurality of parallel rows 1 of earthed collecting electrodes 2, which are vertically arranged in succession in the respective rows. Each row 1 of collecting electrodes consists of substantially plate-shaped, sectional metal sheets, which between themselves thus form gas passages for the dust-laden gas to be cleaned. The gas flow in the electrostatic precipitator occurs horizontally as indicated by arrow G. Between each row 1 of collecting electrodes 2, discharge electrodes (not shown) are accommodated, which are connected to a negative voltage.

As indicated in Fig. 1, the collecting electrodes 2 of each row are at their upper ends attached by means of rivets or bolts to a horizontally oriented, flexurally rigid carrier element in the form of a U-beam 3. The U-beam 3 is in turn separately and movably suspended by means of connecting elements, which in the embodiment illustrated consist of two inclined, elongate round bars 4a, 4b. The round bars 4a, 4b are positioned in the plane of the row and are oriented in such a manner that their lower ends

face each other and make an angle α of about 10° relative to a vertical axis V extending through the respective round bars. The lower ends of the round bars 4a, 4b are secured to the end portions of the U-beam 3 in the upper flange thereof, and the upper ends of the round bars are secured to the casing 5. Because of this, according to the invention, special suspension of the U-beam 3 and the fact that the collecting electrodes 2 are in direct contact with the U-beam 3, a very small amount of the rapping force is absorbed by the casing 5, which results in efficient cleaning. Besides, the horizontal pivoting motion of the row 1 of collecting electrodes arising during cleaning will be minimal.

In the illustrated embodiment, the rapping mechanism 6 for cleaning the collecting electrodes 2 of each row is arranged in the centre of the U-beam 3 and comprises a rapping hammer 7, which acts in a vertical plane about a rotary shaft 8 extending horizontally in the transverse direction of the electrostatic precipitator, and an anvil 9. As shown in Fig. 1, the anvil 9 in the form of an L-beam is directly fixedly mounted by means of bolts on the upper side of the U-beam 3 and comprises a rapping shoulder 10. The U-beam 3 thus serves as carrier element as well as rapping means for the collecting electrodes 2. During cleaning, the U-beam 3 is subjected to a horizontally directed motion by the rapping hammer 7 giving the rapping shoulder 10 arranged on the anvil 9 a rap, which is transferred in the form of a shock wave to the collecting electrodes 2 via the carrier beam 3. The rapping point of the rapping hammer 7 thus is placed in such a manner that it is located above the horizontal centre line C of the U-beam 3, which is also evident from Fig. 4. The shock wave spreads downwards along all the collecting electrodes 2 of the row 1, which are thus caused to vibrate, whereupon the dust layer is loosened by the vibrations. The dust particles then fall into a collecting hopper (not shown) pertaining to the respective precipitation fields.

The illustrated device further comprises control means which consist of upper and lower control elements for controlling the motion of each row 1 of collecting electrodes in the transverse as well as longitudinal direction of the electrostatic precipitator. In order to prevent, during the cleaning operation, flashover because of the motion of the row 1 in the transverse direction of the electrostatic precipitator, the U-beam 3 is provided with upper control elements in the form of upper cam control elements 11a, 11b, which at each end of the U-beam 3 cooperate with the web thereof. The upper cam control elements 11a, 11b also constitute a certain control of the carrier element 3 of the row, and thus the row, in the longitudinal direction of the electrostatic precipitator, especially at small angles α. In the embodiment illustrated,

the upper cam control elements 11a, 11b extend horizontally through a plurality of rows in the transverse direction of the electrostatic precipitator.

In the embodiment illustrated, the lower ends of the collecting electrodes 2 are for each row loosely controlled in the longitudinal as well as transverse direction of the electrostatic precipitator by means of lower control elements, which will appear from the following description.

As shown in Figs 1 and 2, the lower ends of the collecting electrodes are inserted between a pair of rods in the form of flat iron rods 12a, 12b horizontally oriented in the longitudinal direction. In this manner, the flat iron rods prevent the motion of the collecting electrodes 2 in the transverse direction of the electrostatic precipitator. The control of the collecting electrodes 2 in the longitudinal direction of the electrostatic precipitator is carried out by means of spacer members 13 arranged before, after and between the collecting electrodes 2. The spacer members 13 are fixedly mounted in the transverse direction across the rods 12a, 12b as shown in Fig. 3. Moreover, the row 1 of collecting electrodes is controlled in the transverse direction of the electrostatic precipitator by means of lower cam control elements 14a, 14b which are vertically oriented in the transverse direction and arranged at the ends of said pairs of rods. The rods 12a, 12b are further provided with a supporting suspension 15 in the centre of the row 1. The control described above is designed with regard to thermal expansion. The distance between the pair of rods is fixed by spacer members (not shown), which in suitable positions are arranged between the rods.

The invention is, of course, not restricted to the embodiments described above and can be modified in various ways within the scope of the appended claims.

For instance, the lower ends of the collecting electrodes 2 can be firmly controlled instead of loosely controlled.

For instance, the anvil 9 can be designed so as to extend across at least two successive parallel rows 1 of collecting electrodes 2 in the transverse direction of the electrostatic precipitator, instead of across a single row.

CLAIMS

1. A device in an electrostatic precipitator for the suspending, controlling and rapping of one or more collecting electrodes (2) arranged essentially vertically in one or more substantially parallel rows (1), said device comprising for each row (1) a substantially horizontally oriented carrier element (3) to which the upper ends of the collecting electrodes (2) are attached, connecting elements (4a, 4b) which connect the carrier element (3) to the casing (5) of the electrostatic precipitator, control means (11a, 11b, 12a, 12b, 13, 14a, 14b) for controlling the motion of each row (1) of collecting electrodes in the transverse and/or longitudinal direction of the electrostatic precipitator, and a rapping mechanism (6) for rapping the collecting electrodes (2) of each row and comprising a rapping means (7), such as a rapping hammer, and an anvil (9) connected to the carrier element (3), c h a r a c t e r i s e d in that the carrier element (3) of each row is separately suspended by means of said connecting elements (4a, 4b), thereby permitting, during rapping, a minimum horizontal pivoting motion restricted to each row (1) of collecting electrodes and occurring in the longitudinal direction of the electrostatic precipitator.

2. The device as claimed in claim 1, c h a r a c t e r i s e d in that the connecting elements of the carrier element (3) comprises two elongate rods (4a, 4b), each making an angle α, relative to a vertical axis (V) extending through each rod, in the range of about 5-35°, preferably in the range of about 5-15°, in such a manner that said rods (4a, 4b) are positioned substantially in the plane of the row such that the distance between their lower ends is smaller than between their upper ends.

3. The device as claimed in claims 1 and 2, c h a r a c t e r i s e d in that the control means consist of upper control elements (11a, 11b) cooperating with the carrier element (3), and/or lower control elements (12a, 12b, 13, 14a, 14b) cooperating with the lower ends of the collecting electrodes (2).

4. The device as claimed in claim 3, c h a r a c t e r i s e d in that the upper control elements consist of upper cam control elements (11a, 11b) cooperating with the end portions of the carrier element, said cam control elements extending substantially horizontally in the transverse direction of the electrostatic precipitator.

5. The device as claimed in claim 3 or 4, c h a r a c t e r i s e d in that the lower ends of the collecting electrodes are loosely controlled by the lower control elements (12a, 12b, 13, 14a, 14b) on the one hand in the transverse direction of the electrostatic precipitator by means of a longitudinally oriented, horizontal pair of rods (12a, 12b), such as flat iron rods, between which the lower ends of the collecting electrodes are arranged and, on the other hand, in the longitudinal direction of the electric precipitator by means of spacer members (13) arranged before, after and/or between the collecting electrodes (2).

6. The device as claimed in claim 3 or 4, c h a r a c t e r i s e d in that the lower ends of the collecting electrodes are firmly controlled by the lower control elements (12a, 12b) in the transverse as well as longitudinal direction of the electric precipitator by means of longitudinally oriented, horizontal rods, to which the lower ends of the collecting electrodes are attached.

7. The device as claimed in claim 5 or 6, c h a r a c t e r i s e d in that each row (1) is controlled in the transverse direction of the electrostatic precipitator by means of transversely oriented lower cam control elements (14a, 14b) arranged at the ends of said rods.

8. The device as claimed in any one of claims 1-7, c h a r a c t e r i s e d in that the anvil (9) is directly fixedly mounted on the upper side of the carrier element and comprises a rapping shoulder (10) which is the rapping point of the rapping means (7) which is arranged in such a manner that the rapping point is located above the horizontal centre line (C) of the carrier element.

9. The device as claimed in any one of claims 1-7, c h a r a c t e r i s e d in that the anvil (9) extends across at least two rows (1) of collecting electrodes (2) in the transverse direction of the electrostatic precipitator and is directly fixedly mounted on the upper side of the carrier element (3) of each row.

10. The device as claimed in claim 8 or 9, c h a r a c t e r i s e d in that the rapping means (7) acts in a vertical plane about a rotary shaft (8) extending substantially horizontally in the transverse direction of the electric precipitator, the rapping means giving the anvil (9) a horizontally directed rap during rapping.

AMENDED CLAIMS

[received by the International Bureau on 27 November 1996 (27.11.96); original claims 1-10 replaced by amended claims 1-10 (2 pages)]

1. A device in an electrostatic precipitator for the suspending, guiding and rapping of one or more collecting electrodes (2) arranged substantially vertically in one or more substantially parallel rows (1), said device comprising for each row (1) a substantially horizontally oriented supporting element (3) to which the upper ends of the collecting electrodes (2) are attached, connecting elements (4a, 4b) which connect the supporting element (3) to the casing (5) of the electrostatic precipitator, guiding means (11a, 11b, 12a, 12b, 13, 14a, 14b) for guiding the motion of each row (1) of collecting electrodes in the transverse and/or the longitudinal direction of the electrostatic precipitator, and a rapping mechanism (6) for rapping the collecting electrodes (2) of each row and comprising a rapping means (7), such as a rapping hammer, and an anvil (9) connected to the supporting element (3), the supporting element (3) of each row being separately suspended by means of said connecting elements (4a, 4b), c h a r a c t e r i s e d in that said connecting elements (4a, 4b) are movable fastened and formed as elongated rods, each constituting an angle (α), relative to a vertical axis (V), lying within the range of 5-35°, thereby enabling, a limited, minimal, horizontal pivoting motion of each row (1) of collecting electrodes in the longitudinal direction of the electrostatic precipitator during rapping.

2. The device as claimed in claim 1, c h a r a c t e r i s e d in that the connecting elements of the supporting element (3) formed by two elongated rods (4a, 4b), each constituting an angle (α), lying within the range of 5-15°, and arranged in such a manner that said rods (4a, 4b) are positioned substantially in the plane of the row such that the distance between their lower ends is smaller than between their upper ends.

3. The device as claimed in claims 1 and 2, c h a r a c t e r i s e d in that the guiding means consist of upper guiding elements (11a, 11b) cooperating with the supporting element (3), and/or lower guiding elements (12a, 12b, 13, 14a, 14b) cooperating with the lower ends of the collecting electrodes (2).

4. The device as claimed in claim 3, c h a r a c t e r i s e d in that the upper guiding elements consist of upper cam guiding elements (11a, 11b) cooperating with the end portions of the supporting element, said cam guiding elements extending substantially horizontally in the transverse direction of the electrostatic precipitator.

5. The device as claimed in claim 3 or 4, c h a r a c t e r i s e d in that the lower ends of the collecting electrodes are loosely guided by the lower guiding elements (12a, 12b, 13, 14a, 14b) on the one hand in the transverse direction of the electrostatic precipitator by means of a longitudinally oriented, horizontal pair of bars (12a, 12b), such as flat iron bars, between which the lower ends of the collecting electrodes are arranged and, on the other hand, in the longitudinal direction of the electrostatic precipitator by means of spacer members (13) arranged before, after and/or between the collecting electrodes (2).

6. The device as claimed in claim 3 or 4, c h a r a c t e r i s e d in that the lower ends of the collecting electrodes are firmly guided by the lower guiding elements (12a, 12b) in the transverse as well as the longitudinal direction of the electrostatic precipitator by means of longitudinally oriented, horizontal bars, to which the lower ends of the collecting electrodes are attached.

7. The device as claimed in claim 5 or 6, c h a r a c t e r i s e d in that each row (1) is guided in the transverse direction of the electrostatic precipitator by means of transversely oriented lower cam guiding elements (14a, 14b) arranged at the ends of said bars.

8. The device as claimed in any one of claims 1-7, c h a r a c t e r i s e d in that the anvil (9) is fixedly mounted directly on the upper side of the supporting element and comprises a rapping shoulder (10) forming the rapping point of the rapping means (7), said shoulder being arranged in such a manner that the rapping point is located above the horizontal centre line (C) of the supporting element.

9. The device as claimed in any one of claims 1-7, c h a r a c t e r i s e d in that the anvil (9) extends across at least two rows (1) of collecting electrodes (2) in the transverse direction of the electrostatic precipitator and is fixedly mounted directly on the upper side of the supporting element (3) of each row.

10. The device as claimed in claim 8 or 9, c h a r a c t e r i s e d in that the rapping means (7) operates in a vertical plane round a rotary shaft (8) extending substantially horizontally in the transverse direction of the electrostatic precipitator, said rapping means giving the anvil (9) a horizontally directed rap during rapping.

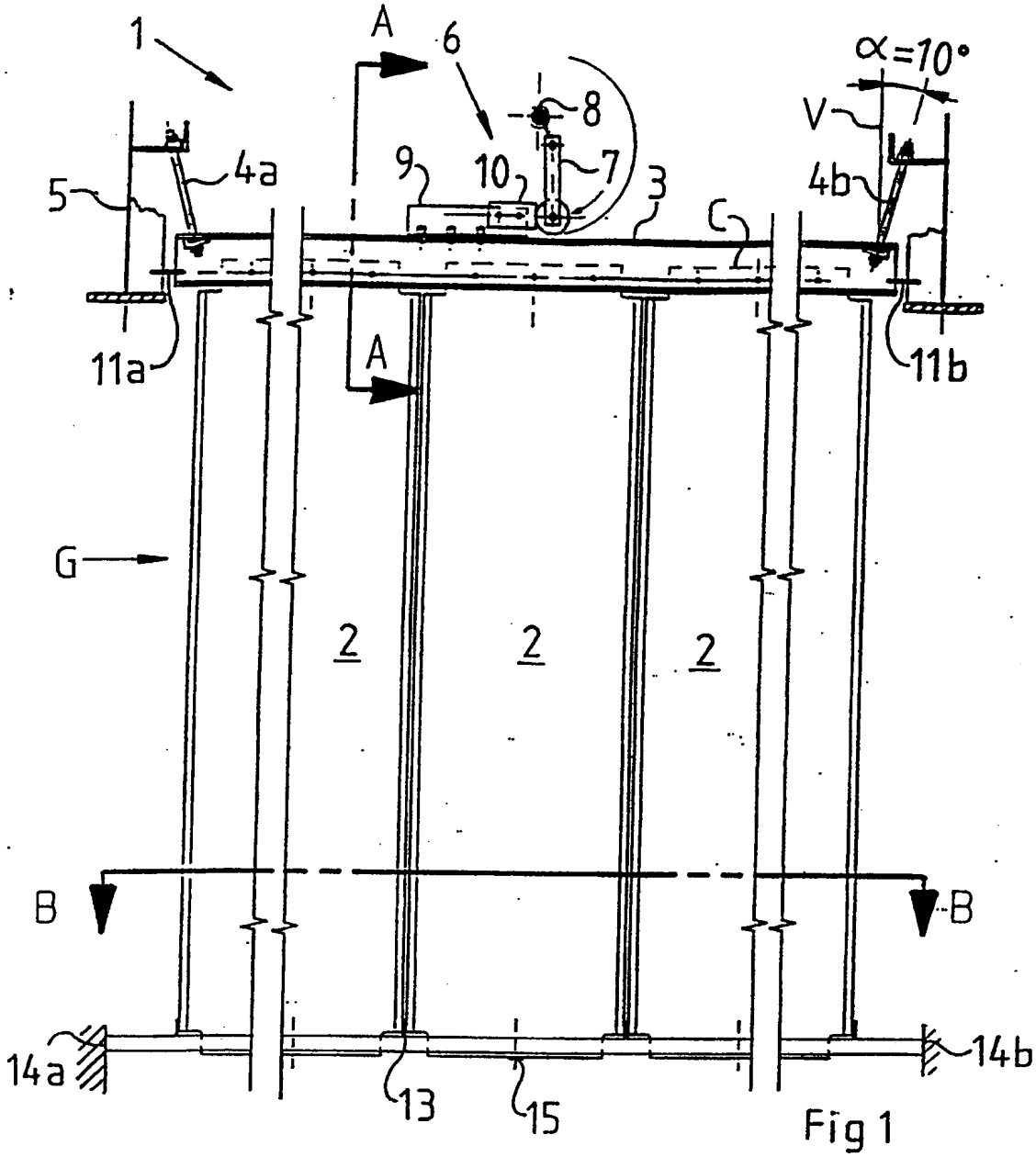

Fig 1

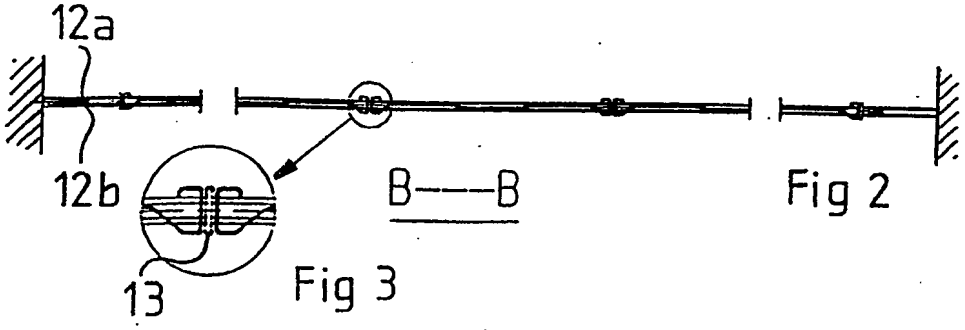

Fig 3

B——B

Fig 2

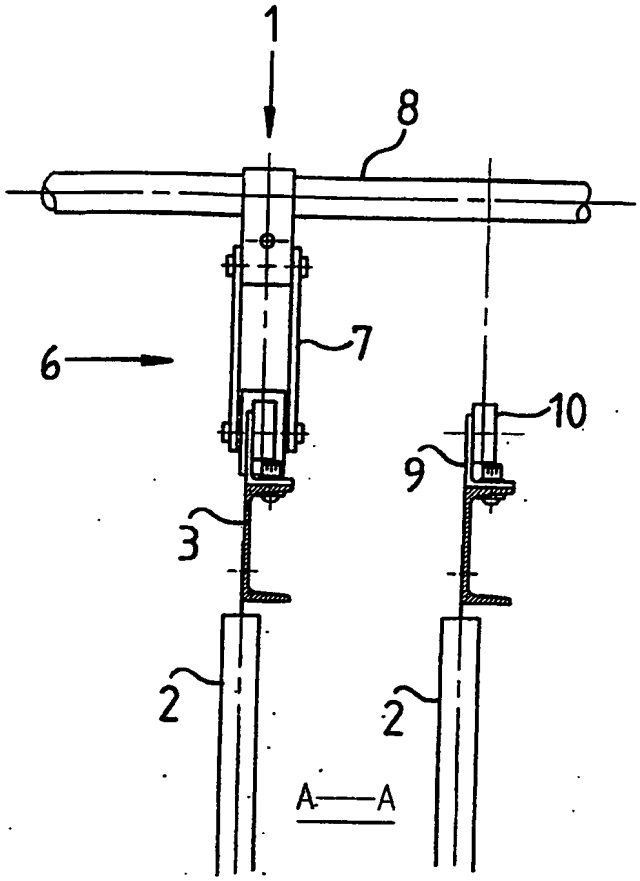

Fig 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/00611

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B03C 3/74, B03C 3/86
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B03C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0662347 A1 (FLS MILJO A/S ET AL), 12 July 1995 (12.07.95), column 3, line 30 - line 36, figures 1, 2, abstract	1,8,10
X	EP 0584880 A1 (FLS MILJO A/S), 2 March 1994 (02.03.94), figures 1,3,4, claim 1, abstract	1,8-10
A	DE 1632459 A1 (KLÖCKNER-HUMBOLDT-DEUTZ AG), 10 December 1970 (10.12.70), figures 1,2, claim 1	1

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 October 1996	19 -11- 1996
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Ulf Nyström Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/00611

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DK 64898 A (F.L. SMIDTH & CO. A/S), 21 October 1946 (21.10.46), page 2, column 1, line 6 - column 2, line 7, figure 1	1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

05/09/96

International application No.
PCT/SE 96/00611

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A1- 0662347	12/07/95	NONE		
EP-A1- 0584880	02/03/94	CA-A-	2104936	01/03/94
		CN-A-	1084783	06/04/94
		DK-A-	107692	01/03/94
		PL-A-	300224	07/03/94
		US-A-	5366540	22/11/94
DE-A1- 1632459	10/12/70	US-A-	3427787	18/02/69
DK-A- 64898	21/10/46	NONE		